

Book Review: Well Worth the Weight!

Molecular Biology of the Cell, 4th ed., by B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter, 2002, 1463 pp., Garland Science (New York, NY);
<http://www.garlandscience.com/>

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As a professor who teaches cell and developmental biology to undergraduate majors, I am always searching for the best textbook. My definition of “best” has multiple components. The best textbook must cover the latest ideas, techniques, and facts and have clear illustrations that enhance the text. It must also provide sufficiently detailed background information so students get a sense of the history and chronology of scientific discoveries. And, perhaps most important, it must contain in-depth mechanistic information within a framework that connects experiment with biological problem. There are many excellent textbooks that fulfill my first and second criteria, and these I use frequently to provide supplemental information on specific topics. However, for an upper-level course that goes into some depth on a subset of cell biology rather than broadly surveying the facts, mechanistic details and scientific rationale are essential to keep the students engaged. The third edition of *Molecular Biology of the Cell* satisfied the latter criterion as well. In fact, I assigned it well beyond its overall usefulness simply because it thoroughly covered many topics so well. With the release of the Fourth Edition, I can again settle in with one textbook for the foreseeable future!

The new edition covers topics very similar to those in the previous version but it has been significantly updated and revised. The first glimpse of its modernization comes in Chapter 1, “Cells and Genomes,” which highlights organismal variety. Instead of focusing on the differences between prokaryotes and eukaryotes as in the previous editions, this chapter highlights the similarities including gene families and protein homologies. Model organisms are described with an eye toward disclosing the distinct advantages of different species for answering various biological questions. Evolution of genomes is incorporated to show the similarities and differences among bacteria, yeast, plants, worms, flies, mice, and humans. One comes away from this chapter with a sense of why scientists use a variety of model systems for their studies but without a sense that certain models are less relevant to the “human condition.” With its overview of basic cellular molecules and processes, this chapter also lays the groundwork for the next 24 chapters.

Numerous new techniques and reagents have been introduced into biologic research in the recent past, and these are covered very well in this edition. As microscopy is the primary technique used by all cell biologists, it is essential that it receives sufficient coverage, and it certainly does here. Chapter 9, on visualizing molecules and cells, includes all the latest imaging techniques and microscopic innovations and the use of fluorescent molecules such as GFP and aequorin. Importantly, the authors have not sacrificed descriptions of how different types of microscope work or eliminated the images from the old microscopy standbys—electron, confocal, phase, and differential interference. Chapter 8 covers other relevant methods such as culturing cells, isolating cell components, manipulating DNA and proteins, and analyzing gene expression. These chapters present an up-to-date resource not only for undergraduates but also for grad students, postdocs, and even faculty who need to get up to speed on some of the latest techniques.

Weighing in at about 7 pounds, *Molecular Biology of the Cell*, fourth edition, certainly cannot be taken lightly. This book is nothing if not comprehensive. It is divided into five parts, each part composed of chapters on related topics. The first three parts would make a very good text for an introductory molecular biology course. In addition to descriptions of basic cell components, how the cell works, and techniques for studying cells and molecules in Parts I and III, Part II contains four chapters on chromosomes, DNA replication and recombination, from DNA to RNA to protein, and control of gene expression. Parts IV and V should be required reading in any cell biology course. Everything intracellular is discussed in the nine chapters in Part IV. Processes common to all cells are described in detail and highlighted with structures or functions that are unique to specialized cell types, including plant cells. The breadth of these chapters provides the information necessary for any student to understand how cells work. Part V then puts intracellular activities and cell specialization into biological context with chapters on cell interactions and extracellular matrix, germ cells, development, tissue formation, cancer, and the immune system. The last part also contains the single new Chapter 25, “Pathogens, Infection, and Innate Immunity,” which brings us almost full circle by reintroducing prokaryotes within the context of eukaryotic disease.

To my delight, many of the classic illustrations that so succinctly explained certain biologic processes have been

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retained and, in many cases, updated. Panel 16-2 has always been one of my favorites because of the clarity with which it describes the biochemistry and regulation of actin and tubulin polymerization reactions. The usefulness of multiple protein binding motifs (Figure 15-53), genetic and biochemical approaches to decipher vesicular transport (Panel 13-1), and the key features of collagen fibril assembly (Figure 19-47) are just some of the figures that I have used repeatedly and that appear in this edition as well. There are many examples in this book where recent information from the research literature has been integrated into old figures. For example, a subtle yet very important change has been made to Figure 19-58, where the basement membrane is now shown assembled on a cell surface rather than floating in midair as in the previous edition. This is just one small example of the attention to detail paid during the revision of this text.

Over the years I have accumulated review articles, schematics, diagrams, and figures from research papers and other texts to supplement my lectures. Topics such as cytoskeletal associated proteins, regulation of the cell cycle and of cell death, nuclear import/export, SNAREs and other vesicle proteins, membrane domains, and various aspects of cell adhesion have changed dramatically since the third edition of Alberts *et al.* These areas have been significantly updated, usually in some detail, which will allow me to reduce the supplemental handouts and instead send the students to this textbook for the latest information.

It is likely that a reader of this or any other text can always find some omissions in his or her research area. And that is also the case with this fourth edition. I have always thought that one chapter (Chapter 19 here) is the bare minimum needed to cover all of cell-cell adhesion and cell-extracellular matrix adhesion including components, functions, and downstream effects. Fortunately, Chapter 22, on tissue organization, adds to these basics by putting cell inter-

actions with their surroundings into various biological contexts. Even so, some relevant and important information, for example, signal transduction by integrin receptors, is glossed over. Integrins connect extracellular matrix to the actin cytoskeleton via focal adhesion complexes as illustrated in Figure 19-12. Focal adhesions also contain a number of signaling molecules, none of which are represented in the figure. However, images showing focal adhesion localization of signals such as phosphotyrosine residues and focal adhesion kinase (FAK) do show up in other figures (17-50 and 19-66, respectively). The addition of FAK and phosphotyrosine to the focal adhesion diagram in Figure 19-12 would illustrate the dual role of these receptors as organizers of both the cytoskeleton and signaling cascades. Inclusion of this principle in the chapter on cell communication would also underscore the idea that cells must integrate signals from multiple sources.

While there may be some omissions, I want to emphasize that they do not detract from the excellence of this textbook. Its quality is further enhanced by the various teaching aids that are available. The textbook is accompanied by *Cell Biology Interactive*, a CD-ROM with animations, movies, and high-resolution images to illustrate further concepts and processes from all chapters. Another CD-ROM, *The Art of MBoC4*, is available with all figures for use in computer presentations and lectures. Additional teaching supplements include the problems book *A Problems Approach*, a transparency set of selected figures, and Garland Science Classwire, a web site with instructional resources and access to figures from other Garland textbooks.

Even though I have a set of perfectly good Powerpoint lectures based on another textbook, I plan to spend this semester revamping my lectures to correspond with this fourth edition. Now that this excellent textbook is finally here, I plan to take full advantage of its depth and breadth.